Evoked thrill: A simple intraoperative maneuver predicts early patency of arteriovenous fistulas

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Arteriovenous fistula at the wrist has remained the procedure of choice for long-term chronic hemodialysis since its development by Brescia and Cimino in 1966.[1] However, the early failure rate (<30 days) remains a significant problem, affecting 24% of patients in a series reported by Palder.[2] Beyond the first month, the long-term patency rate for radiocephalic fistulas is excellent.

Compromised venous outflow from the fistula, usually because of preexisting areas of segmental stenotic lesions, is the most common cause of early failure. The cephalic vein must be investigated all the way from the wrist by clinical inspection, preoperative color Doppler imaging, intraoperative venography, or angioscopy.[3,4] We describe a simple intraoperative maneuver that can be used to detect proximal stenotic vein segments.

METHODS

The radial artery and cephalic vein are exposed and mobilized through a standard longitudinal incision parallel with the lateral border of the forearm. A venotomy approximately 0.8 cm long is performed, and a small plastic tube (e.g., 14-gauge catheter with a 2 mm external diameter) is gently inserted through the opening. The catheter is connected to a syringe containing heparinized physiologic saline, and the surgeon injects 20 ml of saline while holding the syringe with his left hand. The saline is injected by applying pressure intermittently, mimicking the pulsed arterial flow. While injecting saline, the surgeon palpates the skin over the proximal vein with his right hand, and if there is no stenotic lesion, an evoked thrill is felt (Fig. 1). When a palpable thrill is produced, the surgeon proceeds with an arteriotomy in the radial artery and performs an arteriovenous anastomosis. When no thrill is produced, the surgeon should suspect the existence of a stenotic lesion or areas of thickened vein wall. For these cases, "on table" venography is performed to reveal the exact nature of the lesion, and unnecessary arteriotomy of the radial artery is avoided. After the saline injection, the tube is left in place to avoid occluding the vein with vascular clamps. The proximal vein is irrigated periodically with heparinized saline solution through the catheter threaded up its lumen, ensuring patency while a vessel loop placed around the intubated vein prevents backbleeding. The distal venous limb is always ligated on completion of the anastomosis to avoid venous hypertension of the hand.

RESULTS

From November 1996, when the evoked thrill maneuver was introduced as a routine technique in every autologous arteriovenous fistula procedure (except basilic transpositions), through August 1997, 49 consecutive patients who underwent 52 autologous access operations were identified by retrospective review of their records. The clinical details of the patients in the study group are summarized in Table I.

The evoked thrill maneuver was performed in all 49 patients. When the thrill was produced, the test result was considered negative (i.e., proximal vein stenosis was unlikely). In the absence of an induced palpable thrill, the test result was considered positive (i.e., proximal vein stenosis was likely). The early failure rate for the series was 17%, with nine arteriovenous fistulas thrombosed within the first postoperative month. For four of the nine early failures, the evoked thrill test results were positive. The

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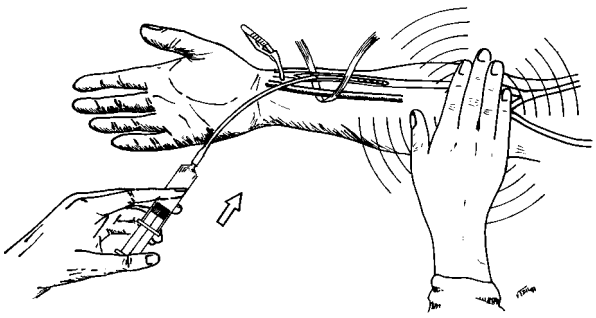

Fig. 1. An evoked thrill is palpable with the surgeon's right hand while he is injecting the saline through an intravenous catheter and holding the syringe with his left hand. The saline is injected by applying pressure intermittently, mimicking the pulsed arterial flow.

Table I. Clinical details of 49 consecutive patients who underwent 52 autologous arteriovenous fistula procedures

Age (yr)	mean = 57.5; range, 16–83
Male/female	32/17
Access type	
Radiocephalic fistulas at wrist	31
Radiocephalic fistulas at forearm	10
Brachiocephalic fistulas at elbow	11
Primary/secondary procedures*	42/10

*A procedure was considered secondary when a previous access had failed in the ipsilateral limb.

decision to proceed with the procedure in these patients despite a positive test result was based on free and easy passage of the catheter through the vein from the wrist to a level above the antecubital fossa. The existence of a proximal stenotic, nondistensible vein segment with thickened intimal surface was revealed by direct dissection when the access was revised in two patients and in a third patient by table venography. In the latter case, no revision was performed. The cause of early failure was not disclosed for all patients with negative test results, but in two it correlated with premature puncture during the second postoperative week. Table II compares the results of the evoked thrill maneuver with the early failure rate.

No false-positive test results occurred. The early failure rate is a better criterion of efficacy of the maneuver than long-term patency. The latter is affected by factors such as puncture timing and technique and by development of neointimal hyperplasia.

Table II. Comparison of evoked thrill maneuver results with the early failure rate for 52 autologous arteriovenous fistulas

	*Evoked thrill maneuver**	
Early failure (<30 d)	*Negative responses*	*Positive responses*
Yes	5	4
No	43	0

*For the evoked thrill maneuver: sensitivity = 44%, specificity = 100%, positive predictive value = 100%, and negative predictive value = 89%.

DISCUSSION

Thrombosis is the most common reason for early arteriovenous fistula loss. Thromboses within the first 4 to 6 weeks postoperatively are caused by technical problems at the anastomosis or stenotic lesions of the more proximal vein.[5] The latter are caused by prior episodes of phlebitis and usually are not recognized preoperatively. The most common lesions occur in regions of previous thrombosis and recanalization; these are webs, strands, or areas of nondistensible vein with a thickened intimal surface.

Proximal stenotic lesions should be recognized preoperatively or intraoperatively, but because no consensus exists regarding the ideal preoperative screening method for access surgery, most surgeons are satisfied with preoperative clinical evaluation of the vein, including tourniquet application and vein percussion.[5] However, preoperative clinical examination, with or without a tourniquet, and direct intraoperative inspection of the vein frequently fail to detect proximal stenotic lesions. Preoperative Duplex scanning or intraoperative angioscopy are more accurate methods for assessing the quality of venous outflow. Duplex scanning has an 88% specificity for detecting the suitability of the arm veins for access surgery,[3] but not all centers performing vascular access are equipped with color Doppler or angioscopy. Because angioscopy requires clearing the vein of blood, some irrigation fluid is necessary, but some patients cannot tolerate this procedure.[4]

Presence of a palpable thrill postoperatively is the best indicator of good venous runoff, whereas the absence of a thrill and the existence of strong pulsations of the proximal vein suggest outflow obstruction and demand access revision.[6] The evoked thrill is a simple method that can be used to reproduce flow conditions and prevent inadvertent arteriotomy and subsequent compromise of distal perfusion. In

our series the evoked thrill maneuver, with a sensitivity of only 44%, failed to locate about one half of the early failures. The reason appears to be that early failure is not always caused by a proximal vein stenotic lesion; systemic pressure drop, premature cannulation, and inadequate inflow also cause early failures. However, the positive predictive value (of an early failure) of the test was 100%, indicating that this maneuver is highly accurate in predicting early thrombosis and constitutes a simple and useful intraoperative method for improving the patency rate of autologous arteriovenous fistulas.

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